

Appl. No. 09/729,806  
Amdt. dated May 3, 2004  
Reply to Office Action of March 1, 2004

### AMENDMENTS TO THE CLAIMS

The listing of claims below replaces all prior versions, and listings, of claims:

- 1           1.       (Currently Amended) A database system comprising:  
2                   one or more storage devices containing a table having plural rows,  
3                   the plural rows including a first row containing a before image  
4       representing data in a portion of the table before a data modification operation and a  
5       second row containing an after image representing data in the portion of the table  
6       processed by the data modification operation.
- 1           2.       (Original) The database system of claim 1, wherein the one or more  
2       storage devices further contain identifiers to identify a state of each row.
- 1           3.       (Original) The database system of claim 2, wherein the identifiers are  
2       contained in the table.
- 1           4.       (Currently Amended) The database system of claim 1, wherein each of the  
2       first and second rows are associated with ~~one~~ a row identifier, the row identifiers of the  
3       first and second rows having a first value.
- 1           5.       (Original) The database system of claim 4, wherein the table further  
2       contains state identifiers to identify a before image state of the first row and an after  
3       image state of the second row.
- 1           6.       (Original) The database system of claim 1, wherein the data modification  
2       operation is performed in a transaction, the transaction having one or more requests,  
3       wherein the first row contains a transaction before image representing data before the  
4       beginning of the transaction, and wherein the plural rows further comprise a third row  
5       containing a request before image representing data before the beginning of a request in  
6       the transaction.

Appl. No. 09/729,806  
Amdt. dated May 3, 2004  
Reply to Office Action of March 1, 2004

1           7.       (Original) The database system of claim 5, further comprising a module  
2 adapted to transition the state of each row based on a data manipulation command.

1           8.       (Original) The database system of claim 1, further comprising a module  
2 adapted to return data in the second row in response to a read request under a normal  
3 condition.

1           9.       (Original) The database system of claim 8, wherein the module is adapted  
2 to return data in the first row in response to a read request under an abort condition in  
3 which the modification operation is aborted.

1           10.      (Original) The database system of claim 9, further comprising a rollback  
2 module adapted to mark the first row as containing a current image in response to the  
3 abort condition.

1           11.      (Original) The database system of claim 10, wherein the rollback module  
2 is adapted to further remove the second row in response to the abort condition.

1           12.      (Original) The database system of claim 1, wherein the table contains a  
2 first row identifier associated with the first and second rows, a first state identifier having  
3 a first value associated with the first row, and a second state identifier having a second  
4 value associated with the second row.

1           13.      (Original) The database system of claim 12, wherein the table further  
2 contains a mutation identifier associated with the first row identifier to identify that the  
3 modification operation is occurring with respect to one or more rows associated with the  
4 first row identifier.

Appl. No. 09/729,806  
Amdt. dated May 3, 2004  
Reply to Office Action of March 1, 2004

1           14.     (Original) The database system of claim 13, wherein the mutation  
2     identifier changes value with each new modification operation.

1           15.     (Currently Amended) ~~The database system of claim 14~~ A database system  
2     comprising:  
3                 one or more storage devices containing a table having plural rows,  
4                 the plural rows including a first row containing a before image  
5     representing data before a data modification operation and a second row containing an  
6     after image representing data processed by the data modification operation,  
7                 wherein the table contains a first row identifier associated with the first  
8     and second rows, a first state identifier having a first value associated with the first row,  
9     and a second state identifier having a second value associated with the second row,  
10                wherein the table further contains a mutation identifier associated with the  
11     first row identifier to identify that the modification operation is occurring with respect to  
12     one or more rows associated with the first row identifier,  
13                wherein the mutation identifier changes value with each new modification  
14     operation,  
15                wherein the data modification operation is performed in a transaction,  
16     each transaction having one or more requests, the mutation identifier having a transaction  
17     identifier portion and a request identifier portion.

1           16.     (Original) The database system of claim 15, wherein the transaction  
2     identifier portion has a value that increments with each new transaction.

1           17.     (Previously Presented) The database system of claim 14, further  
2     comprising a module adapted to return a row based on the mutation identifier and state  
3     identifier information.

Appl. No. 09/729,806  
Amdt. dated May 3, 2004  
Reply to Office Action of March 1, 2004

1           18.     (Original) The database system of claim 14, wherein the one or more  
2     storage devices further contain an active mutation identifier list having one or more  
3     mutation identifiers associated with one or more active modification operations.

1           19.     (Original) The database system of claim 18, wherein the one or more  
2     storage devices further contain an abort mutation identifier list having one or more  
3     mutation identifiers associated with one or more aborts of modification operations.

1           20.     (Currently Amended) A method of providing access in a database system,  
2     comprising:  
3                 storing data in rows of a table; and  
4                 in response to a data modification operation of a first row, marking the  
5     first row as a before image row containing data of the first row before the start of the data  
6     modification operation, and creating a second row as an after image containing data  
7     processed by the data of the first row modification operation,  
8                 wherein the first and second rows are stored in the table.

1           21.     (Original) The method of claim 20, further comprising setting a first state  
2     identifier to a first value to identify the first row as the before image row and setting a  
3     second state identifier to a second value to identify the second row as the after image  
4     row.

1           22.     (Original) The method of claim 21, further comprising returning the  
2     second row in response to a read operation under a first condition.

1           23.     (Original) The method of claim 22, further comprising returning the first  
2     row in response to the read operation under a second condition in which the data  
3     modification operation has been aborted.

Appl. No. 09/729,806  
Amdt. dated May 3, 2004  
Reply to Office Action of March 1, 2004

1           24.     (Original) The method of claim 20, further comprising rolling back to the  
2     first row if the data modification operation aborts.

1           25.     (Original) The method of claim 24, further comprising deleting or marking  
2     as available for reuse the second row during a rollback process in response to the abort.

1           26.     (Original) The method of claim 20, further comprising marking the second  
2     row as a current row if the data modification operation commits.

1           27.     (Original) The method of claim 26, further comprising deleting or marking  
2     as available for reuse the first row once the data modification operation commits.

1           28.     (Currently Amended) An article comprising at least one storage medium  
2     containing instructions that when executed cause a system to:  
3                 store data in rows of a table; and  
4                 store a state identifier associated with each row, the state identifier having  
5     a first value to indicate a first row as being a before image of a data modification  
6     operation on a first portion of the table and a second value to indicate a second row as  
7     being an after image of [[a]] the data modification operation on the first portion of the  
8     table,  
9                 wherein the first and second rows are stored in the table.

1           29.     (Currently Amended) An article comprising at least one storage medium  
2     containing:  
3                 a data structure having plural portions,  
4                 the data structure further containing state identifiers associated with  
5     corresponding portions, a first state identifier having a first value to indicate a first row as  
6     being a before image of a data modification operation on a first portion of the data

Appl. No. 09/729,806  
Amdt. dated May 3, 2004  
Reply to Office Action of March 1, 2004

7 structure, and a second state identifier having a second value to indicate a second row as  
8 being an after image of [[a]] the data modification operation on the first portion of the  
9 data structure.

1 30. (Previously Presented) The database system of claim 1, wherein the table  
2 comprises a relational table for storing data of a database.

1 31. (Previously Presented) The database system of claim 1, further  
2 comprising:  
3 plural storage elements to store the table; and  
4 plural access module processors to enable parallel access of the plural  
5 storage elements.

1 32. (Previously Presented) The method of claim 20, wherein storing the data  
2 in rows of the table comprises storing database data in rows of a relational table.

1 33. (Previously Presented) The article of claim 28, wherein storing data in  
2 rows of the table comprises storing database data in rows of a relational table.

1 34. (Previously Presented) The article of claim 28, wherein the instructions  
2 when executed cause the system to:  
3 respond with data in a row containing an after image in response to a read  
4 request under a normal operating condition; and  
5 respond with data in a row containing a before image in response to a read  
6 request under an abort condition.